SCIENTIFIC NOTE

Nocturnal Behavior of Oriental Fruit Flies and Melon Flies (Diptera: Tephritidae) and Associated Parasitoids in a Commercial Papaya Growing Region on Kaua'i, Hawai'i

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ABSTRACT. Nocturnal behavior of the Oriental fruit fly, *Bactrocera dorsalis* and the melon fly, *Bactrocera cucurbitae*, was observed in and around a commercial papaya orchard in Moloa'a, Kaua'i, Hawai'i. A panax species, *Polyscias guilfoylei*, planted as a windbreak in 2 areas of Moloa'a, was found to be the major mating and roosting site for *B. dorsalis* while *B. cucurbitae* mated and roosted primarily in a hedgerow of wili wili, *Erythrina tahitensis*. Roosting sites for fruit fly parasitoids were not identified. Potential use of hedgerow windbreaks as traps for fruit fly control is discussed.

INTRODUCTION

In behavioral studies with Oriental fruit fly, *Bactrocera dorsalis* (Hendel), and its associated braconid parasitoids, Stark et al. (1994) found that these species spent the entire day in and around guava trees. Food sources, oviposition sites, and roosting sites (areas where flies remain during hours of darkness) were readily available in guava trees. In a similar study in papaya, it was noticed that *B. dorsalis* and its parasitoids left papaya trees around dusk (Stark unpubl.). I initially hypothesized that papaya trees did not provide adequate protection for these species because the papaya canopy, unlike commercial guava, is very sparse. A study was conducted to determine what plant species were used by *B. dorsalis* at night. I also studied melon fly, *Bactrocera cucurbitae* (Coquillett) and 4 parasitoids associated with these fruit flies, *Biosteres arisanus* (Sonan), *B. vandenboschi* (Fullaway), *Diachasmimorpha longicaudata* (Ashmead), and *Psyttalia incisi* (Silvestri), in and around a commercial papaya growing area in Moloa'a, Kaua'i.

MATERIALS AND METHODS

The major habitats in Moloa'a, as described by Vargas et al. (1990) (papaya fields, melon fields, vegetable fields, strawberry guava stands, java plum forest, common guava stands, sugarcane, ironwood forest), were initially examined by random walks starting at 1600 h and at 2-hour intervals until 0600 h the following day on 2 occasions (9, 16 June 1988). I also examined mixed weeds and any other plants encountered. Fifteen minutes were spent in each habitat walking a transect where possible, examining the under and upper surfaces of the leaves as well as the stems, trunks, and fruits of the various plant types mentioned above. The same transects were walked at each time interval. Flashlights were used between sunset and sunrise to conduct the survey. As noted in a previous study, the light from flashlights did not disturb *B. dorsalis* or *B. cucurbitae* (Stark et al. 1994). On the first 2 sampling dates, no flies or parasitoids were found in any of the areas studied except for an occasional fly on papaya. However, large numbers of flies were found in 2 hedgerows bordering papaya fields. The hedgerows consisted of a panax species, *Polyscias guilfoylei* (W. Bull) L.H. Bailey, planted as a windbreak in 2 areas of Moloa'a. The 2 panax hedgerows were located in quadrat 13 (see Vargas et al. 1990) and bordered papaya fields. The first hedgerow (hedgerow 1) was approximately 90 m long, 2.5 m high, and 1 m wide. The second hedgerow (hedgerow 2) was the same height and width as the first, but was only 45 m long. A more intensive sampling of the hedgerows was conducted on 6 more occasions throughout the summer of 1988 (7, 12, 20 July; 3, 11, 16 August). On 7 July 1988, the number of flies occupying the leaves of each entire hedgerow were counted hourly from 1800 to 0600 h. Flies stopped moving just after dark and remained basically motionless until sunrise. Counting hourly provided no more additional information than a single count after dark so counts were taken at 1000 h on subsequent sampling dates. The surface of leaves of each hedgerow were examined thoroughly for flies and parasitoids on each sampling date.

RESULTS AND DISCUSSION

Female *Bactrocera dorsalis* were observed landing on panax leaves in the hedgerows around dusk and congregating in large numbers primarily on the lower surfaces of the leaves in the upper canopy. Male flies appeared to follow females into the windbreak to mate, lagging behind females sometimes as much as 30 minutes. This behavior seemed to contradict lek behavior where male flies establish lek sites and draw females into an area. Mating occurred in the panax hedgerows and little movement of *B. dorsalis* occurred after mating was complete. *Bactrocera dorsalis* remained in the hedgerow until sunrise at which point they were observed moving into the papaya orchard. The number of flies observed in the hedgerows varied between sampling dates (Table 1). Although the numbers appear low, it was difficult to get an exact count of *B. dorsalis* in hedgerows because of the thick canopies and the height at which some flies resided.

Bactrocera cucurbitae were occasionally found roosting in panax. However, the majority of *B. cucurbitae* were found roosting in a hedgerow of wili wili, *Erythrina tahitensis* Nadeau (= *E. sandwicensis* Degener), in quadrat 17 (see Vargas et al. 1990). This hedgerow was approximately 46 m long, 7.6 m high and 1 m wide. Unlike the behavior observed by female *B. dorsalis*, both *B. cucurbitae* females and males appeared to move into wili wili around the same time (dusk). *B. cucurbitae* was never observed roosting in vegetable crops or any other plant species other than wili wili or panax. Numbers of *B. cucurbitae* observed in wili wili are presented in Table 1.

Table 1. Total number (♀ & ♂) of *Bactrocera dorsalis* (on panax) and *B. cucurbitae* (on wili wili) found in hedgerows at 1000 h during survey dates in 1988.

Species	Hedgerow number	7 July	12 July	20 July	3 Aug	11 Aug	16 Aug
Bactrocera dorsalis	1	53	106	28	43	136	70
	2	22	56	34	16	88	40
Bactrocera curcubitae	—	14	7	13	12	6	8

Braconid parasitoids of oriental fruit fly were observed during the day in papaya trees, but were rarely observed in papaya orchards after dark. Although an intense effort was made, parasitoid roosting sites were never identified in Moloa'a.

The roosting behavior observed in this study is in direct contrast to that observed in a nearby commercial guava orchard in Kilauea (Stark et al. 1994). In the guava orchard, *B. dorsalis* were found roosting in guava trees. Several parasitoid species were also found roosting in guava trees (Stark et al. 1994).

Both *B. dorsalis* and *B. cucurbitae* may mate and roost in other plant types not identified in Moloa'a. Nishida & Bess (1950) found that melon flies were attracted to a series of plants other than the vegetable crops in which they developed. The majority of melon flies in a watermelon and tomato growing area spent most of the day outside of the growing area. Because *B. dorsalis* and *B. cucurbitae* spend part of the day outside of certain crops, there is potential for control with insecticides on these non-host plants. Panax and wili wili hedgerows are commonly planted throughout Hawai'i as windbreaks. Insecticides could be applied to these hedgerows thereby avoiding direct application of insecticides to crops. Parasitoids of fruit flies should be preserved in this manner because they appear to use different roosting sites. Previous work has indicated that this approach will not work in commercial guava (Stark et al. 1994). Whether this approach would work in other crop systems is unknown and should be investigated in future studies.

The reason panax and wili wili hedgerows are used by *B. dorsalis* and *B. cucurbitae* as roosting sites in Moloa'a is unknown. Perhaps this phenomenon can be explained by my initial hypothesis that the foliage of papaya trees is very sparse and may not provide enough protection. Many vegetable crops in Moloa'a also provide little in the way of dense foliage like that found in hedgerows. Also, vegetable crops are close to the ground leaving flies vulnerable to predators such as ground beetles. In contrast, commercial guava trees have extremely dense canopies and therefore provide adequate protection for *B. dorsalis*. However, the fact that female *B. dorsalis* seemed to be particularly attracted to panax suggested that an attractant may be present in this plant species. This hypothesis has since been tested in wind tunnel experiments and it was found that a volatile component(s) of panax does act as an attractant to female *B. dorsalis* (E. Jang & J.D. Stark, unpubl. data).

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